YINNIAN FENG, Ph.D.

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EDUCATION

Ph.D. Vanderbilt University, Chemical and Biomolecular Engineering, Nashville, TN **2012 - 2018**

- Dissertation Title: "Biophysical Force on the T-Cell Receptor Fosters Digital Antigen Responsiveness and Exquisite Specificity during T-Cell Activation" *Advisor: Matthew J. Lang*

M.S. Tianjin University, Chemical Engineering and Technology, Tianjin, CN **2009 – 2012**

- Dissertation Title: "Theory and Application of Local Composition for Cocrystal Formation in Solution" *Advisor: Hongyuan (David) Wei*

B.S. Tianjin University, Chemical Engineering, Tianjin, CN **2005 – 2009**

RESEARCH INTERESTS

- Fundamental nature of how cells sense and respond to mechanical stimuli, especially for immune cells.
- High-content, high-throughput, and quantitative single-cell mechanoimmunology with the ultimate goal of promoting health and longevity.
- Chip-free microfluidic Point-of-Care (POC) assays in early diagnosis.
- 3D-printed microfluidic devices and their potential biomedical applications.

RESEARCH EXPERIENCE

Assistant Professor **2026 – present**
Department of Bioengineering *Boston, MA*

- Microfluidics
- High-throughput biophysics
- High-throughput mechanobiology
- High-throughput mechanoimmunology
- Chip-free microfluidic diagnostics for early disease diagnosis and health promotion

Microfluidics Senior Scientist **2021 – 2025**
Chemical Biotechnologies - Merck *Rahway, NJ*

- High-throughput protein engineering and antibody discovery via vortex-based microfluidics.
- 3D printed microfluidic system for flow chemistry.

Postdoctoral Scholar **2018 – 2021**
Department of Genetics - Stanford University *Stanford, CA*
Advisor: Polly M. Fordyce

- Developed a new technology named BATTLES (Biomechanically-Assisted T-cell Triggering for Large-scale Exogenous-pMHC Screening) to probe the force- and sequence-dependent landscape of T-cell responses in high throughput.
- Invented a new droplet-based microfluidic tool for high-throughput production of spectrally encoded beads (MRBLEs 2.0).
- Applied MRBLEs 2.0 to rapidly screen for the presence of multiple bacteria species in a single reaction (MRBLE-path).
- Applied MRBLEs 2.0 to determine phosphatase preferences in dephosphorylation reactions (MRBLE:Dephos).

Research Assistant **2013 – 2018**
Department of Chemical and Biomolecular Engineering - Vanderbilt University *Nashville, TN*
Advisor: Matthew J. Lang

- Elucidated the whole T-cell mechanome for early T-cell activation using optical tweezers and single-molecule fluorescence microscopy.
- Created a single molecule tether for various biological motors & receptor-ligand systems.
- Designed and prototyped 3D-printed protein models to improve student understanding of protein structure-function relationships.

ACADEMIC PUBLICATIONS

Peer-reviewed journal articles (original research):

1. ***Feng, Y.***, Zhao, X., White, A.K., Garcia, C.K., and Fordyce, P.M. (2022). "A bead-based method for high-throughput mapping of the sequence- and force-dependence of T-cell activation", ***Nature Methods*** *19(10)*, 1295-1305.
    - Technology highlighted in "Method to Watch 2022": Mukhopadhyay M. (2023) "Immunomechanics", ***Nature Methods*** *20*, 35.
    - Research Briefing: Fordyce, P.M. and ***Feng, Y.*** (2022). "BATTLES: high-throughput screening of antigen recognition under force", ***Nature Methods*** *19*, 1189–1190.
2. Akitsu, A., Kobayashi E., ***Feng, Y.***, Stephens, H.M., Brazin, K.N., Masi, D.J., Kirpatrick, E.H., Mallis, R.J., Duke-Cohan, J.S., Booker M.A., Cinella V., Feng W.W., Holliday E.L., Lee J.J., Zienkiewicz K.J., Tolstorukov M.Y., Hwang W., Lang M.J., Reinherz E.L. (2024). "Parsing digital or analogue TCR performance through piconewton forces", ***Science Advances***, *10*, eado4313.
3. Emmert M.H., Bottecchia C., Barrientos R., ***Feng Y.***, Holland-Moritz D., Hughes G., Lam Y.H., Regalado E., Ruccolo S., Sun S., Chmielowski R., Yang C., Lévesque F. (2024). "Build your own" ADC mimics: Identification of non-toxic linker/payload mimics for HIC-based DAR determination, high-throughput optimization, and continuous flow conjugation", ***Organic Process Research & Development***, *28(8)*, 3326-3338.
4. Hein, J.B., Nguyen, H.T., Garvanska, D.H., Nasa, I., Kruse, T., ***Feng, Y.***, Lopez-Mendez, B., Davey, N., Kettenbach, A.N., Fordyce, P.M., and Nilsson, J. (2023). "Global substrate identification and high throughput in vitro dephosphorylation reactions uncover PP1 and PP2A-B55 specificity principles", ***Molecular Systems Biology***, e11782.
5. Zhao, X., Kolawole, E.M., Chan, W., ***Feng, Y.***, Yang, X., Jude, K.M., Sibener, L.V., Fordyce, P.M., Germain, R.N., Evavold, B.D., and Garcia, C.K. (2021). "Tuning T cell receptor sensitivity through catch bond engineering", ***Science*** *376(6589):* eabl5282.
6. ***Feng, Y.***, White, A.K., Hein, J.B., Appel, E.A., and Fordyce, P.M. (2020). "MRBLES 2.0: High-throughput generation of chemically functionalized spectrally and magnetically-encoded hydrogel beads using a simple single-layer microfluidic device", ***Microsystems and Nanoengineering*** *6(1)*, 1-13.
    - Feature Article highlighted on the banner of the journal.
7. Ong, L.L.S., Zhu, H., Banik, D., Guan, Z., ***Feng, Y.***, Reinherz, E.L., Lang, M.J., and Asada, H. (2019). "A robotic microscope system to examine T cell receptor acuity against tumor neoantigens: A New Tool for Cancer Immunotherapy Research", ***IEEE Robotics and Automation Letters*** *4(2)*, 1760–1767.
8. Brazin, K.N., Mallis, R.J., Boeszoermenyi, A., ***Feng, Y.***, Yoshizawa, A., Reche, P.A., Kaur, P., Bi, K., Hussey, R.E., Duke-Cohan, J.S., Song, L., Wagner, G., Arthanari, H., Lang, M.J., and Reinherz, E.L. (2018). "The T-cell receptor α bipartite transmembrane domain coordinates antigen triggering by regulating bilayer immersion, CD3 association and transcriptomes", ***Immunity*** *49(5)*, 829–841.

- "Editor's choice" of ***Science Signaling*** by Williams, E.R. "The basics of mechanotransduction" *11(556)*, eaau2223.
- "Editor's choice" of ***Science Translational Medicine*** by Hinrichs, C.S. "T cell receptors communicate by movement" *10(471)*, eaaw0522.
- Previewed by Lichauco, K., Lee, M.S., and Kuhns, M.S. (2018). "Bonds Voyage! A Dissociative Model of TCR-CD3 Triggering Is Proposed" ***Immunity*** *49(5)*, 786-788.

9. ***Feng, Y.***, Brazin, K.N., Kobayashi, E., Mallis, R.J., Reinherz, E.L., and Lang, M.J. (2017). "Mechanosensing drives acuity of αβ T cell recognition", ***Proceedings of the National Academy of Sciences*** *114*, E8204-E8213.
    - "From the cover" paper, and commented by James, J.R. (2017). "Using the force to find the peptides you're looking for." ***PNAS*** *114*, 10303-10305.
10. Brady, S.K., Sreelatha, S., ***Feng, Y.***, Chundawat, S.P.S., and Lang, M.J. (2015). "Cellobiohydrolase 1 from Trichoderma reesei degrades cellulose in single cellobiose steps", ***Nature Communications*** *6*, 10149.
11. Das, D.K., ***Feng, Y.***, Mallis, R.J., Li, X., Keskin, D.B., Hussey, R.E., Brady, S.K., Wang, J.-H., Wagner, G., Reinherz, E.L., and Lang, M.J. (2015). "Force-dependent transition in the T-cell receptor β-subunit allosterically regulates peptide discrimination and pMHC bond lifetime", ***Proceedings of the National Academy of Sciences*** *112 (5)*, 1517-1522.
12. Hou, X., ***Feng, Y.***, Zhang, P., Wei, H., and Dang, L. (2015). "Selective crystal growth of theophylline-saccharin cocrystal on self-assembled monolayer from incongruent system", ***Crystal Growth & Design*** *15 (10)*, 4918-4924.
13. ***Feng, Y.***, Dang, L., and Wei, H. (2012). "Analyzing solution complexation of cocrystals by mathematic models and in-situ ATR-FTIR spectroscopy", ***Crystal Growth & Design*** *12(4)*, 2068-2078.
14. Li, L., Jiang, Z., Wu, H., ***Feng, Y.***, and Li, J. (2009). "Protamine-induced biosilica as efficient enzyme immobilization carrier with high loading and improved stability", ***Materials Science and Engineering: C*** *29 (6)*, 2029-2035.

Peer-reviewed reviews:

1. ***Feng, Y.***, Reinherz, E.L., and Lang, M.J. (2018). "*αβ* TCR mechanosensing forces out serial engagement", ***Trends in Immunology***, *39(8)*, 596-609.
2. Brazin, K.N., Mallis, R.J., Das, D.K., ***Feng, Y.***, Hwang, W., Wang, J.-h., Wagner, G., Lang, M.J., and Reinherz, E.L. (2015). "Structural Features of the αβTCR Mechanotransduction Apparatus That Promote pMHC Discrimination", ***Frontiers in Immunology*** *6*.

Book chapters:

1. Stephens, H.M., Brazin, K.N., Mallis, R.J., ***Feng, Y.***, Banik, D., Reinherz, E.L., and Lang M.J. (2022). "Measuring αβ T-cell receptor-mediated Mechanosensing using optical tweezers combined with fluorescence imaging", ***Optical Tweezers: Methods and Protocols****,* 727-753.

Abstracts not published in other forms:

1. ***Feng, Y.***, Brazin, K.N., Kobayashi, E., Mallis, R.J., Reinherz, E.L., and Lang, M.J. (2018). "Biophysical features of the αβTCR mechanome that drive high avidity T-cell recognition", ***Biophysical Journal*** *114 (3)*, 201a.
2. Reinherz, E.L., Mallis, R.J., Das, D.K., ***Feng, Y.***, Hwang, W., Wang, J.-h., Wagner, G., Lang, M.J., and Brazin, K.N. (2016). "G-101 Special lecture: The T cell receptor is a mechanosensor", ***JAIDS Journal of Acquired Immune Deficiency Syndromes*** *71*, 64.

CONFERENCE PRESENTATIONS

1. Vortex-based emulsification enables microfluidics-free droplet assays for high-throughput antibody screening (Talk). **Merck Technology Symposium**, NJ (2023)
2. High-throughput functional antibody screening via agarose droplet microfluidics at the single-cell level (Poster). **GRC on High Throughput Chemistry and Chemical Biology,** NH (2023)
3. High-throughput mapping of the sequence- and force-dependent landscape of T cell activation (Talk). **Stanford ChEM-H Postdoc Retreat,** CA (2019)
4. Biophysical features of the αβTCR mechanome that drive high avidity T-cell recognition (Talk). **62nd Annual Meeting Biophysical Society**, CA (2017)
5. Optical trapping combined cell fluorescence to investigating Cβ FG loop regulated mechanotransduction in T cell receptor triggering (Poster). **Janelia Farm Research Campus**, VA (2017)
6. Rapid and Adequate Accumulation of TCR-pMHC Catch Bonds for early T cell Activation (Poster). **AICHE**, GA (2014)
7. Theory and Application of Local Composition for Cocrystal Formation in Solution (Plenary lecture). **1st Asian Crystallization Technology Symposium**, Korea University, Korea (2012)
8. Solution Complexation of Cocrystals is Explained by Mathematic Models and In-Situ ATR-FTIR Spectroscopy (Talk). **10th International Workshop on Crystal Growth of Organic Materials**. University of Limerick, Ireland (2012)
9. Indicator of Cocrystal Stoichiometry in Solution Local Composition and Its Application on Selective Cocrystal Growth (Talk). **4th European Conference on Crystal Growth.** Glasgow, UK (2012),
10. Stoichiometric Diversity of Cocrystals Formed in Solution: Formation Mechanism and a Case Study (Talk). **CGCT-5-Industrial Crystallization**, Singapore (2011)
11. Is Stoichiometric Diversity of Cocrystals Determined by Solution Microstructure? - Molecular Dynamics Approach and a Case Study (Talk). **18th International Symposium on Industrial Crystallization,** Zurich, Switzerland (2011)

PATENTS

1. Methods and compositions for multiple-parameter single-cell analysis using spectrally encoded microbeads. Kara Brower, Polly Fordyce, Alexandra Sockell, Adam White, ***Yinnian Feng*** (2020). International Publication No. WO 2020/243160 A1.
2. High-throughput force-dependent cellular response assay using spectrally encoded smart beads. ***Yinnian Feng***, Adam White, Polly M. Fordyce, Xiang Zhao, K. Christopher Garcia (2022). International Publication No. WO 2022/094219 A1.
3. Methods and compositions related to lanthanide-encoded microbeads. ***Yinnian Feng***, Adam White, Jamin Hein, Polly Fordyce (2021). International Publication No. WO 2021/252735 A1.

AWARDS & GRANTS

1. Best Poster Award at PRD-ET Scientific Summit, Merck 2024
2. Nominated speaker in "Rising Stars in Biological Engineering" seminar at Princeton (declined) 2021
3. Stanford BioX Seed Grant 2020
4. CRI Irvington Postdoctoral Fellowship, Cancer Research Institute 2019

5. School of Medicine Dean's Postdoctoral Fellowship, Stanford University (declined) 2019
6. Best Presentation Award in Stanford ChEM-H Postdoc Retreat, Stanford University 2019
7. Outstanding graduate student research paper in the School of Engineering, Vanderbilt University 2018
8. Best Research Paper Award in ChBE, Vanderbilt University 2018
9. Biophysical Society Education Travel Award 2017
10. Excellent Graduate of Tianjin University 2012
11. First-class National Scholarship for Master Student, Tianjin University 2009, 2010, & 2011
12. Air Product Scholarship, Tianjin University 2010
13. Merit Student, School of Chemical Engineering and Technology 2009
14. Second Prize in the scientific competition of the Challenge Cup at Tianjin University 2008
15. Ten Outstanding Youth in the School of Chemical Engineering and Technology 2008
16. The 9th Election of "Outstanding Student of Science and Technology" of Tianjin University 2007
17. First Prize in the 9th Practice of Student Innovation Project at Tianjin University 2007
18. National Scholarship, Ministry of Education of the People's Republic of China 2006 & 2007
19. Merit Student, Tianjin University 2005

MENTORSHIP

1. Postdoc (Stanford): Margaux Pinney 2021
   - As a mentor, I trained Margaux on multi-channel microscopy for imaging HT-MEK microfluidic chips.
2. Ph.D. student (Stanford): Minsung Cho 2021
   - As a mentor, I trained Minsung on photolithography and fabrication of PDMS microfluidic chips in the clean room.
   - In the daily wet lab training, I taught him the whole procedure of MRBLEs 2.0, MRBLEs 3.0, and multiplex beads imaging using multi-channel microscopy.
3. Postdoc (Vanderbilt): Hai Zhu 2017-2018
   - As a mentor, I trained Hai on measurements of T-cell catch bonds via optical tweezers.
4. Ph.D. students (Vanderbilt): Nikki Rodgers, Mark Hilton, Nikki Reinemann, & Darío Cruz 2016-2018
   - As a mentor, I trained them on all the basic experiments in our single-molecule biophysics lab, ranging from buffer preparation to manipulating optical tweezers.
5. Undergraduate (Vanderbilt): Karen Grebenc 2012-2013
   - As a mentor, I trained Karen on T-cell culture and sample preparation for my T-cell activation experiment.
6. High school student: Ethan Beaty 2016
   - As a mentor, I taught Ethan the basic principle of optical tweezers and ran a simple DNA tether-pulling assay with him.

SERVICE

Organizer, Fordyce Lab Show & Tell in Bioengineering 15-year Anniversary Celebration Oct. 2018

- This Stanford Bioengineering Celebration invited many donors, including Zuckerberg, to attend. As an organizer, I was responsible for preparing photolithography samples for visualization of a MITOMI valved microfluidic device and single-cell loading into picoliter droplets.

Team leader, Tianjin University- IChemE accreditation 2009

- As a team leader of the urea-phosphate project, I built our general to-do list, kept track of the project progress, and designed over 80 piping drawings. Our efforts have assisted Tianjin University in

becoming the first university in China to receive IChemE accreditation.

Chief Secretary, International Symposium on Crystal Engineering & Drug Delivery System **Aug. 2009**

- As a chief secretary of the committee, I was in charge of training volunteers and preparing opening & closing speeches for the university president.

TEACHING EXPERIENCE

BIOE 2365 Bioengineering Measurement, Experimentation, and Statistics, Lecturer **Spring 2026**

Northeastern University Department of Bioengineering (Boston, MA)

- This course introduces the fundamentals of biomedical data acquisition and statistical analysis. Engineering statistics topics include descriptive statistics, probability distributions, hypothesis testing, analysis of variance, and experiment design.

3D Bioprinting, Guest Lecturer **Fall 2017**

Vanderbilt University Department of Chemical and Biomolecular Engineering (Nashville, TN)

- This lecture aims to teach graduate students how to design and 3D-print protein models to improve their understanding of protein structure-function relationships.

Quantitative & Chemical Biology Techniques, Guest Lecturer **Spring 2016**

Vanderbilt University School of Medicine (Nashville, TN)

- This lecture aims to teach medical students the basic principles of single-molecule biophysics and how to think about biology from the physical perspective.

Chemical Engineering Process and Product Design, Teaching Assistant **Fall 2013**

Vanderbilt University Department of Chemical and Biomolecular Engineering (Nashville, TN)

- Assisted in the design and implementation of students' Aspen simulation experiments.

Phase Equilibria and Stage-Based Separations, Teaching Assistant **Fall 2012**

Vanderbilt University Department of Chemical and Biomolecular Engineering (Nashville, TN)

- Assisted in reviewing and assessing student homework assignments, providing constructive feedback and suggestions for improvement.
- Hosted regular and accessible office hours to address student questions, clarify concepts, and provide additional support as needed.